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Cross-cultural Adaptation and Validation of the Hong Kong-Chinese version of Children's Voice Handicap Index (CVHI-10(HK))

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Declaration of interest

None

Abstract

Objective. This study aimed to cross-culturally adapt and validate a Hong Kong Chinese version of the Children's Voice Handicap Index (CVHI-10(HK)) and to examine its psychometric properties as a measure of quality of life (QOL) in dysphonic children.

Method. The English version of Children's Voice Handicap Index-10 was translated and adapted to Hong Kong Chinese. Content validity was obtained from ratings of an expert panel and other psychometric properties were measured from CVHI-10(HK) questionnaires completed by 63 children (Dysphonic group: n = 28, vocally-healthy Control group: n = 35) aged between eight to 14 years.

Results. CVHI-10(HK) showed good psychometric properties. Internal consistency measured with Cronbach's alpha coefficient was 0.787. It also showed excellent content validity (scale-level content validity indices $\geq$ 0.90) and good construct validity (between group difference in total CVHI-10(HK) score: $t(33.62) = 4.393$, $p < 0.001$, Cohen's $d = 1.157$). Analysis on criterion validity revealed a significant and moderate correlation between the total CVHI-10(HK) score and auditory-perceptual ratings on overall severity (Pearson's $r = 0.505$, $p < 0.001$). Receiver operating characteristic analysis showed an excellent intrinsic accuracy in discriminating the two groups of children (area under the curve = 0.808) and suggested a cutoff score of 3 would give the optimal sensitivity and specificity combination of the questionnaire.

Conclusion. CVHI-10(HK) is a valid and sensitive tool that measures QOL in dysphonic children. It is the first self-administered questionnaire that is available to the paediatric dysphonic population in Hong Kong. It may also be used as a screening tool to identify dysphonic children and those who are at risk of voice problems in the local context.

Keywords

Voice disorders

Pediatric dysphonia

Children’s quality of life

Voice Handicap Index (VHI)

Children’s Voice Handicap Index (CVHI)

1. Introduction

Dysphonia in children may be less prevalent than in the adult population [1], and its occurrence rate is highly variable. Prevalence of voice disorders in school-age children was reported to range from 2% to 23.9% in the United States [2-4]. A cross-sectional study in the United Kingdom suggested a prevalence of 6% in a large cohort of eight-year-old children [5]. Other recent studies reported prevalence of 12 % (in Finnish children aged six to ten years) and 53.2% (in Iranian primary school students) respectively [6, 7]. A survey by Lau [8] reported that 5.4% of Hong Kong school-age children encountered voice problems. Despite the high variability in prevalence, voice problems can greatly affect a child's quality of life (QOL). Connor et al. [9] interviewed groups of school-aged children and adolescents regarding their voice problems and more than 75% of the participants considered that their social participation had reduced due to their voice problems. Emotional problems including sadness, frustration or annoyance because of the voice problem were also reported in the study. The negative impacts that childhood dysphonia brings about to QOL in children should not be overlooked.

Comprehensive evaluation of voice disorders has been recommended to be multidimensional [10]. Apart from clinician-centered assessments such as visual- and auditory- perceptual evaluation, and acoustic analyses and aerodynamic measurements; self-reported judgement towards one's voice quality and how the voice problem affects one's quality of life is also considered essential to a holistic voice assessment [11]. Assessment tools that measures QOL in the pediatric population are largely modified from those designed for adults (e.g. Pediatric Voice Symptom Questionnaire (pVSQ) [12], Pediatric Voice Handicap Index (pVHI) [13], Pediatric Voice Outcome Survey (PVOS) [14] and Pediatric Voice-Related Quality-Of-Life

survey (pVRQOL) [15]. One common feature of the above mentioned assessment tools lies in the parent-proxied nature of the questionnaires. It is believed that children may not be able to comprehend written words, and they may lack the maturity and cognitive ability to interpret the terms used in the questionnaires. Parental report is, therefore, considered more valid in documenting the QOL of the dysphonic children [16]. However, it is not uncommon for parents to over- or under-estimate the children's severity of voice problems, as well as the negative impact imposed on the children's QOL due to the voice problems [16]. Alcantara, Ohm and Alcantara [17] investigated the discrepancies between self-reported and parent-proxied questionnaires on QOL measures in the field of chiropractic. Results suggested that parents often overestimated their children's physical functioning ability and underestimated their children's psychological disablement. A study by Theunissen et al. [18] found that parent-proxied and self-reported health-related quality of life only showed low to moderate correlations. Another study by Czyzewski et al. [19] also suggested a low-to-moderate correlation between the parent-proxied and self-reported Quality of Well-being Scale in the Cystic Fibrosis Population. Perez Sousa, Sánchez-Toledo and Gusi Fuerte [20] reported that parent-proxied assessments on health-related QOL may exhibit inter-rater reliability issues, for instance, fewer problems were reported by fathers than by mothers. In order to allow accurate assessment on dysphonic children's QOL, development and validation of self-reported assessment tools are warranted.

Children's Voice Handicap Index-10 (CVHI-10) was developed on the basis of Voice Handicap Index-10 by modifying the statements and wordings so that they are understandable by pediatric clients [21]. It is a ten-item self-administered instrument which reflects the extent of how dysphonia poses negative impacts on children's QOL and children's self-perception of their voice quality. The CVHI-10 is considered an easy-to-administer tool as it is short, and yet,

comprehensive enough to have covered the physical, functional, and emotional aspects. The original CVHI-10 exhibited excellent clinical validity and is a useful tool for both initial assessment and treatment outcome measurement [21]. The Turkish version (TR-CVHI-10) of the questionnaire was found to be valid, reliable and sensitive in assessing voice disorders from children's perspective. Both versions are considered clinically useful in their corresponding culture and population [22].

To date, there is no assessment tool available in Hong Kong that measures QOL of dysphonic children, including both parent-proxied and self-reported ones. The purpose of the present study was to cross-culturally adapt and validate a Hong Kong Chinese version of the Children's Voice Handicap Index (CVHI-10(HK)), as well as to examine its psychometric properties as a measure of QOL in dysphonic children. Specifically, the present study will address: *1) is CVHI-10(HK) a valid and reliable tool to measure the impact of dysphonia towards children's QOL; and, 2) Can CVHI-10 (HK) differentiate dysphonic children from their vocally-healthy peers?* Upon development and validation of the CVHI-10(HK), measurement of voice problem from the children's perspective will be allowed and a valid assessment tool that measures QOL of dysphonic children will be made available in the Hong Kong Chinese population.

2. Method

2.1 Participants

The present study was approved by the Human Subjects Ethics Sub-committee, the Hong Kong Polytechnic University (Ref. HSEARS2018011500). Informed consents were obtained from the parent and/or guardian of all participants. Five dysphonic and ten vocally-healthy children

aged between eight and 14 years participated in the pre-testing at the adaptation phase. They were the first 15 children who enrolled in the study and at the same time fulfilled all the inclusionary/exclusionary criteria. Sixty-three children aged between eight and 14 years participated in the validation phase. They were allocated to the Dysphonic group (n = 28) or the vocally-healthy Control group (n = 35), based on the results from auditory-perceptual evaluation conducted by the author (E.K., a speech therapist who had specialized in voice disorders for over 15 years). Visual-perceptual evaluation through laryngoscopy was not adopted considering the "invasiveness", expected success rate of visualizing the pediatric larynges, and acceptability by of subjects of the procedure. Group allocation based on auditor-perceptual evaluation might deem appropriate as it is considered the "gold standard" in voice evaluation and reflective of the vocal function of subjects. Mean age of the Dysphonic and Control groups were 9.29 years (standard deviation (*SD*) = 1.54) and 10.17 years (*SD* = 1.87) respectively. Other inclusionary/exclusionary criteria included: 1) all subjects had to be native Cantonese speakers, 2) they were able to read and comprehend written Chinese sentences, and 3) they should have no history of neurological and/or hearing impairments. Table 1 summarizes the demographic information of subjects in the two groups.

Table 1 Demographic characteristics of subjects in the Dysphonic and Control groups.

	Dysphonic group (n = 28)		Control group (n = 35)	
	Male	Female	Male	Female
Age group				
7-9 years	14	3	10	5
10-11 years	6	2	5	5
12-14 years	2	1	6	4

2.2 Materials and equipment

Voice samples were recorded using a condenser microphone (AKG, model D5) connected to a sound interface (Focusrite Scarlett 2i2) installed in a laptop computer (Lenovo ideapad y700-15TSK) at a sampling rate of 44100Hz. Voice samples were played through a professional grade head phone (Audio Technica, model M40x) connected to a laptop computer (Lenovo thinkpad T470) for auditory-perceptual rating.

2.3 Procedures

Development of the Hong Kong Chinese version of Children Voice Handicap Index – 10 (CVHI-10(HK)). The English version of the CVHI-10 [21] was translated to Hong Kong Chinese by a Chinese/English bilingual qualified translator (Version 1), before it was back-translated by another Chinese/English bilingual qualified translator. The two translations were reviewed and synthesized by a final year Master of Speech Therapy student who graduated with a bachelor degree in linguistics and the author, a speech therapist who had over 15 years of experience in managing voice disorders (Version 2).

Version 2 of the CVHI-10(HK) was pre-tested on 15 children. They were required to complete the questionnaire and interviewed on their views and suggestions. Modifications were made according to their comments to generate the final version of the CVHI-10(HK) (See Appendix for the forward translation, backward translation and final version of the questionnaire).

Validation process. The CVHI-10(HK) was sent to an expert panel that consisted of three English-Chinese bilingual speech therapists who had over 15 years of experience in managing voice disorders for content validity measurement. Members of the panel were required to rate

the title, instruction, rating descriptors and questionnaire items for their relevance as 1) not relevant, 2) quite relevant, 3) very relevant or 4) absolutely relevant.

The subjects summarized in Table 1 were instructed to complete the CVHI-10(HK). All subjects spent no more than ten minutes to complete the questionnaire. Voice samples were also recorded in a sound-treated room by asking the subject to produce a Cantonese standard sentence (/pa1 pa1 ta2 kɔ1 kɔ1/), using his/her habitual pitch and loudness and at a microphone-to-mouth distance of 30cm, for later auditory-perceptual analyses.

Data extraction. The voice samples were normalized to the same intensity level for auditory-perceptual ratings. Three judges, who were qualified speech therapists and each of them had over ten years of experience in managing paediatric voice disorders, were involved in rating the voice samples. They were blind to the group assignment and purpose of the study. Before the actual rating session, the judges met in a consensus meeting to discuss their ratings on 20 randomly selected voice samples. In the actual rating session, the samples were randomized and played to each judge through headphones in a quiet office. The judges were required to rate the samples on overall severity using a six-point equal appearing interval scale (EAI) (0 = normal, 1 = least severe, 5 = most severe). An EAI scale was adopted since interval data were preferred to ordinal data. A six-point scale was adopted such that the judges could refer the point "0" as "normal". The severity ratings of one to five might appear "less ordinal" to the judges as compared to a five-point scale, in which "1" refers to normal and severity has to be rated with the remaining four points. Ratings from the judges were averaged to obtain a final rating for each sample. Seventeen voice samples were randomly selected and rated for a second time by each judge to obtain intra-judge reliability.

Statistical analyses. All statistical analyses were conducted using the IBM SPSS Statistics 25 software. Internal consistency was analyzed with Cronbach's alpha coefficient. Construct validity was analyzed by comparing the total CVHI-10(HK) scores of the two groups using independent *t*-tests. Inter-judge reliability of the auditory-perceptual ratings were estimated using Intra-class Correlations Coefficient (ICC) based on a mean-rating (k = 3), absolute agreement, 2-way mixed-effects model; whereas intra-judge reliabilities were estimated using ICC based on a single measure, absolute agreement, 2-way mixed-effects model. Criterion validity was analyzed by examining the correlation between total CVHI-10(HK) score and auditory-perceptual rating of overall severity using Pearson's correlation statistics. Sensitivity and specificity were estimated by constructing the receiver operating characteristic (ROC) curve. Alpha levels were set at 0.05 for all statistical tests.

3. Results

3.1 Internal consistency

A Cronbach's alpha coefficient of 0.787 was obtained for CVHI-10(HK) (Cronbach's alpha = 0.787). Table 2 summarizes the Cronbach's alpha if any of the items are deleted from the questionnaire.

Table 2 Summary of Cronbach's alpha coefficients if one of the CVHI-10(HK) items is deleted from the questionnaire.

CVHI-10(HK) item	Cronbach's alpha if item is deleted
Item # 1	0.748
Item # 2	0.793
Item # 3	0.792
Item # 4	0.781
Item # 5	0.798
Item # 6	0.725
Item # 7	0.747
Item # 8	0.756
Item # 9	0.761
Item # 10	0.763

3.2 Content validity

Questionnaire components rated as *very relevant* or *absolutely relevant* by members of the expert panel were regarded as "agreed components". Item-level content validity index (I-CVI), scale-level content validity index based on the average method (S-CVI/Ave) and scale-level content validity index based on the universal agreement method (S-CVI/UA) were calculated as suggested in Yusoff [23] (see Table 3).

Table 3 Results of content validity indices.

Components	I-CVI	S-CVI/Ave for items	S-CVI/UA for items
Title	1.00		
Instruction	1.00		
Rating descriptors	1.00		
Items			
# 1	1.00		
# 2	1.00		
# 3	1.00	0.97	0.90
# 4	1.00		
# 5	0.67		
# 6	1.00		
# 7	1.00		
# 8	1.00		
# 9	1.00		
# 10	1.00		

Note. I-CVI = item-level content validity index; S-CVI/Ave = scale-level content validity index based on the average method; S-CVI/UA = scale-level content validity index based on the universal agreement method.

All components of the CVHI-10(HK) revealed I-CVIs of 1.00, with the exception of Item #5 of the questionnaire, in which I-CVHI equals to 0.67. The two scale-level CVIs, namely, the S-CVI/Ave and S-CVI/UA, were found to be 0.97 and 0.90 respectively.

3.3 Construct validity

The total CVHI-10(HK) scores were compared between the Dysphonic group (mean (*M*) = 5.57, standard deviation (*SD*) = 4.417) and Control group (*M* = 1.69, *SD* = 1.728). Since the Leven's test results showed that the assumption of equal variance was violated ($F = 14.279$, $p < 0.001$), degree of freedom was adjusted for the independent *t*-test. The total CVHI-10(HK) score was significantly higher in the Dysphonic group than in the Control group ($t(33.62) = 4.393$, $p < 0.001$, Cohen's $d = 1.157$).

3.4 Criterion validity

Inter- and intra-judge reliability of the auditory-perceptual analyses of voice samples are summarized in Table 4.

Table 4 Inter- and intra-judge reliability of auditory-perceptual rating on overall severity.

	ICC	*p* value	Level of reliability
Inter-judge reliability	[a]0.806*	<0.01	good
Intra-judge reliability			
Judge #1	[b]0.861*	<0.01	good
Judge #2	[b]0.677*	<0.01	moderate
Judge #3	[b]0.795*	<0.01	good

Note. *$p < 0.05$; ICC = Intraclass correlation coefficient; [a]ICC based on a mean-rating (k =3), absolute-agreement, 2-way mixed-effects model; [b]ICC based on a mean-rating (k =1), absolute-agreement, 2-way mixed-effects model

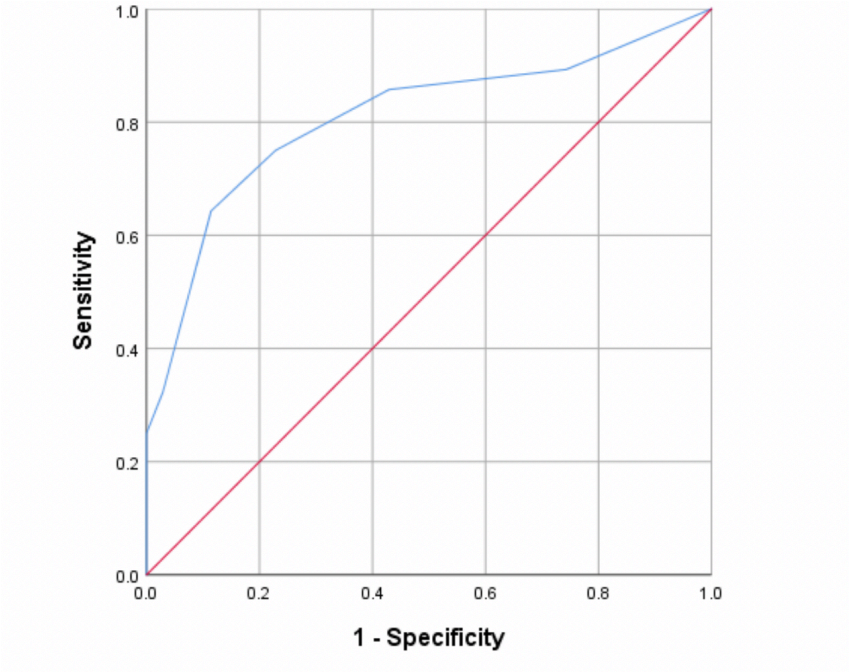
Results of the Pearson's product-moment correlation showed a moderate correlation between the total CVHI-10(HK) scores and auditory-perceptual ratings on overall severity ($r = 0.505$, $p < 0.001$).

3.5 Sensitivity and specificity

The ROC plot is illustrated in Figure 1. The ROC curve was located at the top left corner of the plot and the area under the curve (AUC) was estimated to be 0.808. According to the

coordinates of the curve, maximum sensitivity and specificity resulted from a CVHI-10(HK) score of 2.5 or above (sensitivity = 0.750, specificity = 0.771).

Figure 1 Receiver operating characteristic (ROC) plot of CVHI-10(HK).



4. Discussion

The present study set out to develop and validate the first self-reported assessment instrument for the pediatric dysphonic population in Hong Kong. The CVHI-10(HK) was developed from the original English version through stringent cross-linguistic and cross-cultural adaption processes.

The Cronbach's alpha coefficient of 0.787 suggested the CVHI-10(HK) possessed acceptable internal consistency. Deleting any of the item from the questionnaire would not notably increase internal consistency (i.e. Cronbach's alpha < 0.8 and thus internal consistency remains acceptable). This suggests that the items in CVHI-10(HK) are representative of the construct intended to be measured, that is, the impact of voice disorder on one's well-being from the child's perspective [21, 22].

Excellent content validity was obtained for the title, instruction, rating descriptors and most items of CVHI-10(HK). This suggests that the components are highly relevant to and representative of what the questionnaire is intended to measure [23]. The only item that did not reach universal agreement among all members of the expert panel was Item #5 (*"My voice difficulties reduce my school outcome.")*, and it was rated by one of the panel members as "not relevant". Production of a healthy voice plays a minimal role in children's academic performance in the local context, especially in the primary and early secondary school years. Only a limited portion of the curriculum, for instance, the speaking part of language learning in school, relies on the production of a healthy voice. Such phenomenon in Hong Kong might have led the panel member to regard the item as "not relevant" to the construct of CVHI-10(HK), and thus the failure to establish universal agreement for this particular item. The scale-level CVIs also confirmed the content validity of CVHI-10(HK).

Significant difference in total CVHI-10(HK) scores between the Dysphonic and Control groups suggests that the instrument had good construct validity. It is capable of discriminating dysphonic children from vocally-healthy children. Such findings echo with those of the original and Turkish versions of the CVHI [21, 22], and makes CVHI-10(HK) a clinically useful tool.

It is further supported by the AUC which indicates that the questionnaire has excellent intrinsic accuracy in discriminating the two groups of children [24]. While the score of CVHI-10(HK) may range from 0 to 30, a cutoff score of 3 is recommended considering the optimal sensitivity and specificity combination. It is observably lower than the cutoff score of the Turkish version (i.e. cutoff score = 9) [22], and slightly lower than that of the original version (i.e. cutoff score = 4) [21]. The discrepancies may be attributed to the difference in the children's perception towards the impact of voice problem in different culture. The above-mentioned findings from the present study allow application of the self-administered assessment tool in clinical settings.

The three judges provided reliable auditory-perceptual ratings on voice samples. Auditory-perceptual ratings on overall severity and total CVHI-10(HK) scores were compared for correlation. The statistically significant correlation suggested a positive relationship between the two measures. However, the magnitude of correlation was only considered moderate and this resembled the findings reported in the validation study of the original CVHI-10 [21]. Auditory-perceptual ratings and CVHI-10(HK) scores respectively measure voice problems from the clinician's and children's perspectives. They also measure different levels of disablement (i.e. vocal function and quality of life) in the health condition of dysphonia [25]. It is not uncommon to find them being affected differentially, even in the adult population [26]. The moderate correlation, nevertheless, suggests the complementary relationship between CVHI-10(HK) and auditory-perceptual analyses and reiterates the importance of including both the self-reported assessment tool and the gold-standard of voice evaluation in a comprehensive voice assessment.

Findings of the present study possess important clinical implications. First, the CVHI-10(HK) is the first self-administered assessment tool for pediatric voice disorders available to the Hong Kong Chinese population. It is considered easy to administer as all subjects took no more than ten minutes and required minimal assistance to complete it. The significant differences in total scores between the Dysphonic and Control group, excellent AUC of the ROC curve and cutoff score with reasonable sensitivity and specificity also make the CVHI-10(HK) a favorable screening tool to distinguish vocally-healthy and dysphonic children.

Despite that satisfactory psychometric properties were confirmed for CVHI-10(HK), the present study is not without limitation. The sample size was small and the Dysphonic and Control groups consisted of unbalanced gender ratio and uneven age groups. More male subjects were recruited for the Dysphonic group and it was consistent with the clinical picture in this group of patient, that is, there are more boys than girls in the dysphonic population. Older dysphonic children (i.e. 12-14 years old) were also less likely to be recruited as some of them might fine it difficult to accept the presence of voice problem. This group of children also have more autonomy and were more likely to refuse participation, even though their parents were concerned about their voice problems. These factors made balancing the gender ratio and age group sizes difficult. It is also recommended that test-retest reliability of the questionnaire may be obtained in future studies. This may further justify the application of the CVHI-10(HK) to the pediatric population in Hong Kong.

5. Conclusion

Findings of the present study suggest that CVHI-10(HK) is a valid and sensitive assessment tool on the QOL of children with voice problem. It is not only the first questionnaire that is available to the paediatric dysphonic population in Hong Kong, but also the first self-administered one in the local context. It allows measurement of the impact of voice problem on one's well-being from children's perspective. Further, the cut off score obtained from the present study makes the CVHI-10(HK) a clinically useful screening tool to identify dysphonic children and those at risk of voice problems.

6. Declaration of interest

None

7. Reference

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Appendix – The original, forward translation, backward translation and final version of the Children's Voice Handicap Index-10 (Hong Kong Chinese Version) (CVHI-10(HK))

	Original	Forward Translation	Backward Translation	Final Version
Title	Children's Voice Handicap Index-10 (Hong Kong Chinese Version)	兒童聲線障礙測量表-10	Children's Voice Handicap Index -10	兒童聲線障礙測量表- 10（香港中文版）
Instruction	Instructions: The following sentences are used by many children to describe their voices, and how their voices affect their daily lives. Please **circle** to indicate how often **you** have similar experiences as those children.	指引：以下句子為很多兒童慣常使用來形容他的聲線以及其聲線對他日常生活的影響。請你**以圓圈填選尺度**，以表達**你**有多常擁有相同的經歷。	Instructions: The following sentences are used by many children to describe their voices and how their voices affect their daily lives. Please circle to express how often you have similar experiences as those children.	指引：以下句子為很多兒童慣常使用來形容他的聲線以及其聲線對他日常生活的影響。請你**圈出適當數字**，以表達**你**有多常擁有相似的經歷
Rating descriptors	Never / Sometimes / Many Times / Always	從不 / 間中 / 多次 / 總是	Never / Sometimes / Many Times / Always	從不 / 間中 / 多次 / 經常
Item #1	People have difficulty hearing me because of my voice.	因為我的聲線，人們難以聽到我的說話。	Because of my voice, people can hardly hear me speak	因為我的聲線，別人很難聽到我的說話。
Item #2	People have difficulty understanding me in a noisy room.	人們在嘈雜的房間裡難以明白我的說話。	People have trouble understanding my speech in a noisy room.	在嘈雜的房間裡，人們很難理解我的說話。

Item #3	My voice difficulties prevent me to stay with people.	我的聲線困難阻礙了我與人們相處。	My vocal difficulties made it difficult for me to interact with people.	我的聲線問題阻礙了我與別人相處。
Item #4	I feel left out of conversations because of my voice.	因為我的聲線，我覺得自己在對話中被人忽略。	Because of my voice, I feel neglected in conversations.	因為我的聲線，我覺得自己在對話中被人忽略。
Item #5	My voice difficulties reduce my school outcome.	我的聲線困難影響我的學習成果。	My vocal difficulties affect my learning outcomes.	我的聲線問題影響我的學習成積。
Item #6	I feel I have to strain to produce voice.	我覺得我需要很用力才能發聲。	I feel like I need to try very hard to make my voice heard.	我覺得我需要很用力才能發聲。
Item #7	My voice is not light.	我的聲線並不輕柔。	My voice is not gentle and soft.	我的聲線並不輕柔。
Item #8	My voice problem upsets me.	我的聲線問題使我感到低落。	My voice problems make me unhappy.	我的聲線問題使我感到不快樂。
Item #9	My voice makes me feel inferior to other children or other boys.	我的聲線令我覺得自己不如其他孩子。	My voice made me feel like I am worse than other children.	我的聲線令我覺得自己比其他孩子差。
Item #10	People ask, “What’s wrong with your voice?”	人們問：「你的聲音出了甚麼問題呢？」	People ask "what's wrong with your voice?"	別人會問：「你的聲音出了甚麼問題呢？」

Biography – Elaine Kwong

Elaine Kwong, PhD. is currently an Assistant Professor in the Department of Chinese and Bilingual Studies, Hong Kong Polytechnic University. She is also an experienced speech-language pathologist (SLP) who specializes in managing both adult and pediatric voice disorders. Dr Kwong had delivered courses on clinical management for voice disorders to student SLPs from various institutes in Hong Kong. She also regularly supervises student SLPs in voice clinics. Her research interests include, but not limit to, complementary and alternative medicines for voice disorders, physiology of voice production and vocal fatigue, and prevention of voice disorders in occupational voice users etc.